Typical *Clematis verticillaris* DC., Syst. i. 166 (1817), based on *Atragene americana* Sims, Bot. Mag. xxiii. t. 887 (1806), has the broadly lanceolate to lance-oblong sepals tapering to acute, acuminate or even subulate tips. The sepals vary from 3–5.5 cm. long and when dry are membranaceous and almost translucent, their veins clearly visible, and their backs are only sparsely pilose or glabrescent. This typical *C. verticillaris* occurs from the Gaspé Peninsula of Quebec to Manitoba, thence south to New Brunswick, New England, Delaware, Pennsylvania, northern Maryland, West Virginia, Ohio, Michigan, Wisconsin and northeastern Iowa. Small reports it as extending down the Blue Ridge to North Carolina. I have seen no material from the Blue Ridge of Virginia or North Carolina until the fine sheet from Professor Freer. It is not improbable that the plant of the Blue Ridge of North Carolina may be like that of the Peaks of Otter, which differs from typical *C. verticillaris* in its oblong-elliptic subcoriaceous round-tipped sepals only 2–3.3 cm. long, their backs densely cinereous-pilose. The young foliage, at flowering time is more pilose than in the glabrous or quickly glabrate wide-ranging plant.—M. L. FERNALD.

NOTES ON DRYING PLANTS

JULIAN A. STEYERMARK

A sufficient number of papers have already been published which give ample directions to collectors for preparing and collecting plant specimens[1]. During the past two years a few of them discussed the methods employed and relative advantages obtained in using artificial or natural heat[2]. While each of these articles possesses its own merits, the differences in point of view indicated might suggest that one side favored specimens natu-

[1] 1. BLAKE, S. F. Directions for collecting flowering plants and ferns. U. S. D. A. Dept. Circular 76. 7 pp. Jan. 1920.

2. GLEASON, H. A. and A. C. SMITH. Methods of preserving and arranging herbarium specimens. Jour. N. Y. Bot. Gard. 112–125. 1930.

3. JOHNSTON, I. M. The preparation of botanical specimens for the herbarium. Arn. Arbor. Publ. 33 pp. 1939.

4. FOGG, JOHN M. Suggestions for collectors. RHODORA 42: 145–157. 1940.

[2] Fernald, M. L. Injury to Herbarium Specimens by Extreme Heat. RHODORA 47: 258–260. 1945. Lundell, C. L. A useful method for drying plant specimens in the field. Wrightia 1: 145. 1946. Camp, W. H. On the use of artificial heat in the preparation of herbarium specimens. Bull. Torr. Bot. Club 73: 235–243. 1946.

rally dried, whereas the other preferred those artificially dried. The present writer has had considerable experience in the preparation of herbarium material, and has used the various methods concerned with both the artificial and natural drying of specimens. The purpose of the present paper is to weigh the arguments on both sides, with the hope of showing that each possesses its advantage.

Although artificial heat (electricity, kerosene or gasoline lanterns or stoves) with its accompanying corrugated ventilators (pasteboard or metal) may be used under any circumstances in rainy or dry climates, provided one is equipped to use that form of heat, the same can not be stated for the method of natural drying. During the collecting season in the United States, generally speaking, one can usually depend upon an adequate amount of daily sunshine with its attendant heat to dry a large quantity of plants with driers ("blotters"). It is a simple matter to spread out the absorbent felts in the sun to dry during the hottest parts of the day (generally noon or afternoon), then to pick them up, and finally replace them between the sheets of paper containing the plants. Specimens dried by such natural heat generally appear superior to those dried by artificial heat. The blotter apparently absorbs moisture from the various parts of the plant evenly and gradually; the warmer and drier the blotter, the more rapid the absorbing process. All parts of the plant are pressed flatter with equal pressure applied throughout, so that the specimen never becomes as brittle or inclined to wrinkle unequally as in artificially dried ones, and is more flaccid and softer so that it can be handled without undue breakage. Natural-dried specimens seem to give the best results as far as the appearance and keeping qualities of the specimen are concerned. Where sun is not dependable, and where other methods can be resorted to, similar results may be obtained with driers by using, as did Fernald and Long, heat from the engine room of steamers, or, if one has time, pressing with a hot iron. The latter involves ironing a single specimen at a time and passing a hot iron (electric or carbon) over the blotter which lies on top of the plant specimen. In extreme cases where one is using blotters, and there is no sun, engine room, or hot iron available, the only alternative is to heat the individual blotters over a fire, turning over each side until sufficiently dry and warm. This last method is by far the most time-consuming and laborious, but, in isolated instances, is the only method available and saves the specimen from spoiling.

While there can be no doubt, judging by the writer's own experience, and by the examination of thousands of specimens dried by natural heat, that that method produces the best-looking and best-preserved specimens, yet it is impractical, if not impossible, to use that system in the regions and seasons of heavy rainfall or cloudy humid surroundings. Even though care has been used in the manner of drying with artificial heat, the end result is not as good as that produced by sun-dried blotters. However, and this is the important point, it is far better as Dr. Camp stated, to return with some specimens, though relatively inferior in aspect, from a hitherto uncollected area, than without any specimens at all.

The above statements refer to the overall result yielded by the two methods with an evaluation of their uses under differing conditions of field work. The following statements specifically concern various features of drying specimens with artificial heat. Although this method is used by various collectors in tropical regions, it is employed under varying conditions and in different degrees, so that any uniformity or rule-of-thumb procedure apparently does not exist. This means that the method now employed may be defective in certain respects, leaving various gaps to be filled in and refinements to be made in future field work.

The writer has found that the method roughly outlined by Dr. Lundell[3] is the most practical for field work in tropical and subtropical regions. Since it yields such excellent results, it seems advisable to describe it in somewhat more detail than Lundell has done, in order that certain features of the method may be outlined more fully. Lundell states that "by varying the number of lanterns under a press, and by regulating the height of the flame, the desired amount of heat can be obtained." Stated more definitely, the present writer has observed that usually four kerosene lanterns of standard variety with large glass globes, such as Dietz Junior Wizard, placed equidistant from one another,

[3] Lundell, C. A. A useful method for drying plant specimens in the field. Wrightia 1: 161–162. 1946.

give the best results for a press varying in length from 1½–2½ feet. The four lanterns are placed directly below areas corresponding to the four corners of the press, so that all parts of the press receive approximately the same amount of heat. If the press is very large and bulky, i. e. from 2½–3 feet long, a fifth lantern is generally placed in the center with the other four lanterns at the corners. As the press becomes reduced in size, due to gradual extraction of dried material, one or more lanterns are removed to accommodate the shrinkage in press size. A very small press only 6 inches to a foot thick may require only two lanterns placed at either end. In any event, the lanterns are never placed so closely as to touch, because too much heat may cause overheating of the specimens, causing them to discolor to a marked degree, as well as causing the lanterns to overheat, with a possibly much enlarged flame which in turn leads to smoking of the lantern. Lanterns thus placed are left burning all day and all night. The amount of kerosene held by the type of lantern described above will be adequate to keep the flame going approximately 24–28 hours, after which period the lanterns are removed and re-filled. This is kept up on succeeding days with the collector examining the presses daily to extract the dried plants.

Whether to use corrugated sheets or cartons on either side of the folded paper containing the plant specimen, without the use of driers, or to alternate driers and corrugated sheets is a question often pondered upon in discussions on the subject. In the writer's experience, the best specimens appear to result from the original use of hot dry driers only for the first day. Then, after having been subjected to great pressure, a change is made to artificial heat, using corrugated aluminum sheets or double-faced pasteboard cartons. Depending upon the type of material, the method varies. For example, with very thick palm stems and leaves, bromeliads, orchids, cacti, and other thick bulky materials, the use of aluminum sheets without driers placed on both sides of the specimen is preferable to the pasteboard cartons not only in the matter of drying the specimens more rapidly, but also in that the bending and breaking does not occur as happens when the pasteboard cartons are used for such thick specimens. For normal foliage that is firmly membranaceous to subcoriaceous or coriaceous, either aluminum sheets or double-faced pasteboard cartons without blotters placed on either side of the plant specimen serve the purpose well and give good results. However, for very thin and delicate leaves or flowers, a drier placed on one side of the specimen with a corrugated pasteboard carton or aluminum sheet on the other side, with or without another blotter, prevents the specimen from becoming broken or showing unnecessary corrugations.

Users of kerosene lanterns or lamp stoves should beware of dirty or impure kerosene. Such kerosene results in uneven burning and absorption of carbon particles by the wick, with eventual carbon accumulation on the wick. All this leads to the smoking of the lantern or to extinguishing the flame. Smoking of the lantern is a bothersome situation, requiring the cleaning of the globe and trimming of the wick. If this happens frequently, it can be a most time-consuming job to clean a dozen or more globes and to re-trim wicks. Ordinarily, with the use of clean kerosene it is not necessary to resort to the above procedure more than every other day on the average.

When the lanterns or stoves are first filled one should use care to note that the wick is not turned too high in the beginning, since for the first half hour or so after the wicks are lit in a full lantern, the flame tends to be more active and shoots higher above the edge of the wick. It is well to examine the height of the flame during this period for the first hour. If left unattended, there is every likelihood that the wick may have been raised too high, and, if so, the flame may rise higher than it should and cause smoking. Generally, if such smoking takes place in a kerosene lantern, the smoking tends to smother and extinguish the flame, but in the case of the lamp stoves there is danger, if left unattended, of the flame shooting above, and setting fire to the press. There is real reason, therefore, to watch this part of the drying routine.

Another point which may be mentioned is that of ventilation. Of course, as noted by others, it is essential that the cloth skirt surrounds the press and that it extends from the base of the ground surface to the top, but does not cover the top. Besides this, however, the writer's personal observation is that some ventilation must be provided on one side at the base of the skirt, generally a single flap or opening effected by an upright support from a piece of wood or metal. Such an opening permits a continuous circulation of air to pass from the bottom and to be drawn up through the passages of the corrugations within the press and to pass out eventually at the top. It is well known that not only the factor of heat, but also that of air currents, help to dry out the specimens. It would appear reasonable, therefore, that provision for an opening at the ground level, allowing for greater induction of air currents to pass upwards, would help dry the plant tissues more rapidly. Apparently, such is the case, judging from the writer's personal observations. It may also be mentioned in this connection that lack of such ventilation at the base of the press makes the lanterns heat up too much. Under certain extreme field conditions, however, such as exposure to violent wind- or dust-storms, or excessive rainy or humid weather, it has been found that such basal ventilation is not necessary.

Dr. Lundell suggests that, "the boxes in which the kerosene tins are shipped serve admirably for end supports of the poles where the use of forked sticks is not feasible. In field work in Texas and northern Mexico, a collapsible frame made especially for the purpose has proven satisfactory, for it can be set up in garages of tourist courts, or in other available space." While the writer endorses the above statements, he has found that the boxes used in transporting equipment of the expedition serve as convenient props for the presses. Such boxes are rectangular, about twice as long as wide, and generally 4–6 inches higher than the top of the kerosene lantern. If the lanterns are placed too near the press, they may cause too rapid drying or cooking of the specimens, producing a browning effect, or may even lead to burning of the specimens. On the other hand, if placed too far from the presses, insufficient heat reaches the specimens in a given time and drying proceeds too slowly. If the lanterns are too low, they may be set upon equal supports to bring them up to the desired level. The writer sometimes carries wooden blocks for this purpose. The presses are so placed that just the edges of the press rest on the edges of the box, so that all the specimens within the press receive heat. It is, of course, essential with the use of boxes or any other support that the ground be level. No problem is offered if one has the use of wooden or cement surfaces, but in outdoor camps or native huts where soil is the usual medium, it is necessary to be certain of a uniformly flat surface. An uneven surface may place some of the lanterns or stoves closer to the press than others and effect uneven drying of the specimens. The machete is often found useful in leveling the ground for this purpose.

The above hints in general cover some of the more important problems which one encounters in the routine of drying plants by artificial heat. In the remainder of this article, some notes are appended in connection with certain features of the drying process discussed by Camp, Fernald, and Long. When and how often to straighten the leaves was brought up for discussion in Dr. Camp's paper in reference to a point made by Mr. Long. The writer has found that straightening the parts of the specimen is necessary usually twice, the first time when the specimen is being originally prepared for the press at the time of recording its number and indicating the field data, the second time, at the end of the first 24 hours after being removed from the press with driers, and before being placed in the permanent press of corrugated cartons or sheets. This would corroborate the statements made by Camp that "ample opportunity would be afforded for a preliminary arranging of the specimen as it was first placed in press and also for a final inspection and fixing after the sweating process is complete and just before being placed in position for drying." After the first 24 hours most of the specimens are still fresh enough to have their leaves straightened and to have the necessary arranging attended to. As Dr. Camp states "it is a rare specimen indeed which at the end of a 24-hour period of sweating is not sufficiently tamed that its parts will not lie in place when arranged for the final drying."

In his final remarks Dr. Camp intimates that it is part of the job of drying plants with artificial heat to "wake up two or three times during the night and crawl out from between warm blankets to check the fires and see that the press fastenings are snug". Actually, my own experience does not bear this out. Before retiring the present writer checks the flame and wicks on the kerosene lanterns and checks on the press straps to see that they are tight so that the press is not loose. There is no need of getting out again during the night to check such details, and upon the following morning the re-examination of the lanterns and press straps is made. With sufficient practice and regularity of this habit such matters take on a routine nature without so much as a disturbance of one's slumber.

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POSTGLACIAL FOREST SUCCESSION, CLIMATE AND CHRONOLOGY IN THE PACIFIC NORTHWEST (A REVIEW OF THE STUDY BY HENRY P. HANSEN[1]).— Dr. Hansen presents in this paper the results of many years of painstaking investigation of peat deposits in the Pacific Northwest. Most of the data used have come from profiles of pollen-bearing strata located in western Washington and western Oregon, though some representative profiles were also made in the eastern parts of these states and in northern Idaho.

The paper will be of great value in the development of the study of pollen analysis in America, not only because of the care and thoroughness with which the work itself has been done, but also because of the skill utilized by the author in placing the many profiles studied in their proper topographic and geographic positions. One of the criticisms that can be leveled against much of the pollen analytical work done in America has been the lack of its proper correlation with the physiographic history of the regions involved.

Volcanic eruptions in the Northwest coastal area during postglacial time have caused the deposition of ash over wide areas. The precise dates of the eruptions are not fixed, but Prof. Hansen has used the ash layers to very good advantage as points of correlation among his various peat profiles.

The paper as a whole is divided into 13 chapters or sections, with an extensive list of references and an index at the end. The chapters fall into three groups, the first of which contains introductory and general descriptive matter. The second consists of an analysis of the various profiles studied, in terms of general postglacial vegetational history. Finally, there is the author's discussion of his findings as they indicate postglacial climate and chronology.

Following acknowledgments and introduction, there is a brief history of pollen analysis and a discussion of the theories upon which it rests. Then comes an account of the geologic origins and ages of land surfaces in the Pacific Northwest. In this and the following chapter, which is on pollen-bearing profiles of the Pacific Northwest, the geographic subdivisions for the entire discussion are set up. These subdivisions are looked upon as natural areas. They "approximate physiographic divisions, but they are delimited largely upon the basis of homogeneity of vegetation and climate, and to some extent by the geologic history." The natural areas are: Olympic Mountains, Coastal Strip, Klamath-Siskiyou region, Oregon Coast Range, Puget-Willamette lowland, Cascade Mountain range, Northern Great Basin, Blue Mountains, Columbia Basin, and the region of northeastern Washington and northern Idaho.

The next two chapters deal with the late-glacial and post-glacial chronology of the region and with the probable rate of organic deposition in various areas. In a chapter on methods and technique, the author explains with great care his methods of collecting and preparing samples, and outlines the technique of sampling used in his statistical studies of fossil pollens. Perhaps the most important part of this chapter is concerned with the much debated problem of the identification of the pollens. The author makes free use of the size-range method of checking fossil pollen identification, and utilizes size-frequency

[1] Trans. Amer. Phil. Soc. N. S. Vol. 37, Pt. 1: 1–130. 114 text figures, map. 1947. $2.25.